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published in

The Journals of Gerontology. Series B : Psychological Sciences and Social Sciences
2008

DOI (link to publisher)

[10.1093/geronb/63.5.p279](https://doi.org/10.1093/geronb/63.5.p279)

document version

Publisher's PDF, also known as Version of record

[Link to publication in VU Research Portal](#)

citation for published version (APA)

Eggermont, L. H. P., & Scherder, E. J. A. (2008). Ambulatory but sedentary. Impact on the rest-activity rhythm and cognition in nursing home residents with dementia. *The Journals of Gerontology. Series B : Psychological Sciences and Social Sciences*, 63 B(5), 279-287. <https://doi.org/10.1093/geronb/63.5.p279>

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Ambulatory but Sedentary: Impact on Cognition and the Rest–Activity Rhythm in Nursing Home Residents With Dementia

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Physical activity has been positively associated with cognition and the rest–activity rhythm. In the present study, nursing staff classified ambulatory nursing home residents with moderate dementia either as active ($n = 42$) or as sedentary ($n = 34$). We assessed the rest–activity rhythm by means of actigraphy, and we administered neuropsychological tests to assess cognitive functioning. Compared with the group that was considered sedentary, the group that was considered active had a significantly better rest–activity rhythm, indicating agreement between nursing staff classifications and data gathered by the actigraph. Cognitive function was related neither to active–sedentary classification nor to actigraph measures. Similar ambulatory nursing home residents with dementia may show considerable differences in their level of daily physical activity and in their rest–activity rhythm, but the precise relationship among all variables requires further investigation.

Key Words: Cognition—Rest–activity rhythm—Sedentary.

SEVERAL important behavioral phenomena, such as rest–activity and sleep–wakefulness, are known to show a circadian rhythm, that is, a rhythm of approximately 24 hours (Van Someren, Mirmiran, & Swaab, 1993). A disturbance in the circadian rest–activity rhythm indicates a dampening of the circadian rhythm amplitude, implying that the difference between periods of rest and activity becomes smaller (Van Someren et al., 1993). In older people, deterioration of the rest–activity rhythm is common, and rest–activity rhythm disturbances are even more pronounced in people with dementia (Ancoli-Israel et al., 1997; Van Someren et al., 1996). For example, rest–activity rhythm disturbances in persons with Alzheimer’s disease (AD) are characterized by a decrease in the stability of the rhythm across days, a higher fragmentation of the rhythm within 24 hours, and nocturnal restlessness (Van Someren et al., 1996). The rest–activity rhythm in persons with AD is also characterized by a weak coupling to environmental cues such as light exposure and physical activity, that is, *zeitgebers* (Ancoli-Israel et al.; Van Someren et al., 1996). There are several factors that may have a negative impact on the rest–activity rhythm in persons with dementia. One of these factors is living in a nursing home, because of the associated acoustic noise and nightly nursing care routine (Schnelle, Alessi, Al-Samarrai, Fricker, & Ouslander, 1999). In addition, comorbid conditions such as sleep-disordered breathing (Gehrman et al., 2003) and polypharmacy (Cramer, Chaponis, Bauwens, & Chamberlain, 1999) are associated with rest–activity disturbances. In AD, particularly the dysregulation of the suprachiasmatic nucleus has been reported to play a pivotal role in the often disturbed rest–activity rhythm (Van Someren et al., 1996).

Researchers have emphasized the complexity of factors that influence the rest–activity rhythm in persons with dementia (McCurry & Ancoli-Israel, 2003). One factor that has repeatedly been linked to rest–activity disturbance in persons

with dementia is level of physical activity. More specifically, rest–activity rhythm disturbances in patients with AD are strongly associated with decreased levels of daytime physical activity (Van Someren et al., 1996). In addition, nursing home residents with dementia show more rest–activity disturbances and less daytime physical activities than do residents without dementia (Paavilainen et al., 2005). Furthermore, a higher level of physical activity is related to rest–activity rhythm *maintenance* in nursing home residents with dementia (Sullivan & Richards, 2004). In view of this relationship between daytime physical activity and the overall rest–activity rhythm, it is not surprising that nursing home residents with dementia that are confined to a wheelchair show the most severe disturbances of the rest–activity rhythm (Richards, Beck, Shue, & O’Sullivan, 2005).

Some researchers have reported correlations between rest–activity disturbances and dementia severity (Bliwise, 2004). However, others have reported an inverted U relationship between rest–activity disturbances and cognitive functioning in dementia. This implies that dementia severity is correlated with rest–activity disturbance but peaks at a certain severity, after which more severe dementia is related to less rest–activity disturbance (Van Someren et al., 1996). In people with moderate-stage dementia, a disturbed rest–activity rhythm appears to be related to cognitive dysfunction (McCurry et al., 1999). In addition, daytime sleepiness is associated with cognitive dysfunction in patients with AD (Bonanni et al., 2005). In a group of older women with dementia living in assisted care facilities, stability of the rest–activity rhythm across days was associated with cognitive functioning (Carvalho-Bos, Riemersma-Van Der Lek, Waterhouse, Reilly, & Van Someren, 2007). A possible mechanism could be choline hypofunction in AD, which plays a pivotal role in both the disruption of the rest–activity rhythm as well as in cognitive dysfunction (Schliebs & Arendt, 2006).

Adding to the complexity of the story, physical activity and cognition are associated with each other as well. More specifically, higher levels of physical activity are associated with higher levels of cognitive functioning, especially executive functioning, and, consequently, with a reduction of the risk for dementia (Churchill et al., 2002; Scherder, Eggermont, Sergeant, & Boersma, 2007). In order to benefit both the rest-activity rhythm as well as the cognition of older nursing home residents with dementia, encouragements have been made to increase their daytime physical activity (Koch, Haesler, Tiziani, & Wilson, 2006). The level of physical activity can differ among nursing home residents; *ambulatory* nursing home residents may also show varying levels of physical activity, such as differences in endurance and speed of movement (Kochersberger, McConnell, Kuchibhatla, & Pieper, 1996). However, being able to walk does not necessarily mean being physically active. Crucially, initiating physical activities is considered to be part of executive functioning, and executive functioning is often impaired in older people with dementia (Stout, Wyman, Johnson, Peavy, & Salmon, 2003). For instance, in patients with AD, apathy is very common (Craig, Mirakhor, Hart, McIlroy, & Passmore, 2005). It is associated with impairment in activities of daily living (Stout et al.). Moreover, older women with dementia living in assisted care facilities who engaged in few daytime physical activities had the most impaired activities of daily living (Carvalho-Bos et al., 2007), which, in turn, are known to rely heavily on executive functioning (Scherder et al.).

The aforementioned results suggest that a given sample of people with dementia living on psychogeriatric wards may show varying levels and patterns of daytime physical activity. Some older people with dementia do not engage in physical activities, such as walking, despite being physically capable (Scherder et al., 2007). Conversely, some older people with dementia are known to show excessive motor behavior such as pacing, and even pacing can be reflected as a stronger rest-activity rhythm (Van Someren et al., 1996). However, pacing is a type of physical activity that can hardly be resolved by the nursing staff (Hermans, Htay, & McShane, 2007). In the present study, our focus was on goal-directed behavior, which potentially could be encouraged by the nursing home staff to improve resident functioning. We investigated whether ambulatory nursing home residents at similar stages of dementia varied in their level of goal-directed physical activity, and whether this variation in daytime physical activity was reflected in the rest-activity rhythm and cognitive functioning. We hypothesized that sedentary residents would show greater disturbances of the rest-activity rhythm and of cognitive functioning (e.g., executive functioning) than would active residents.

METHODS

Participants

Participant selection.—A convenience sample of nursing home residents was recruited from 17 nursing homes in the Netherlands. This study was part of a larger study for which approval was granted by the local Medical Ethical Committee.

All participants gave their oral consent and their families or caretakers gave written consent. Inclusion criteria were as follows: participants had to be older than 70 years of age, and they had to have a diagnosis of dementia or the presence of cognitive deterioration as reported in the medical status. We focused on nursing home residents with dementia because these individuals often show reduced initiation of physical activity (Scherder et al., 2007). Participants also had to have a mean score between 10 and 24 on the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975), and they had to be ambulatory (i.e., be capable of walking short distances with or without a walking aid, such as a cane or walker).

Exclusion criteria were as follows. We excluded participants if there were reports by the nursing staff of pacing behavior; if they had a medical diagnosis of a neurodegenerative disease characterized by movement disabilities, such as Parkinson's disease; if they had the current presence of psychiatric disorders that may influence cognition (e.g., psychosis and delirium, disturbances of consciousness, and alcohol abuse); or if there was documentation in their medical status of a history of other nonneurodegenerative conditions that may influence cognition or locomotion, such as head injury, hydrocephalus, and epilepsy (Swaab, 2004). Application of the inclusion and exclusion criteria resulted in a study population of 76 nursing home residents.

Participant classification.—In the nursing home setting, the application of objective measurements of, for instance, the rest-activity rhythm by means of equipment is often limited because of the costs of the devices and appropriate software, the necessity of know-how of analyzing the data, and reports of noncompliance of nursing home residents with dementia (Van Someren, Kessler, Mirmiran, & Swaab, 1997). Therefore, in order to facilitate application of the present findings to the nursing home setting, and corroborating the evidence that nurses' evaluations of the level of activity parallel actigraphy data and data from an accelerometer (Kochersberger et al., 1996; Nagels et al., 2007), we asked the nursing staff to differentiate sedentary from active residents. We asked the head of the nursing staff, a registered nurse, to categorize patients, in agreement with other members of the nursing staff team (including at least one frontline nurse and, if employed at the ward, an occupational therapist). Categorization was based on goal-directed physical activity. We asked the nursing staff to remember whether residents had engaged in the following activities during the past 2 weeks: (a) walking over the ward for reasons other than attending meals (i.e., taking initiative to change location during the day); (b) participating without a wheelchair in trips outside the nursing home; (c) participating in scheduled activities, such as callisthenics or games (e.g., playing shuffleboard); and (d) helping with cooking chores, such as washing the dishes. The people that engaged in at least two of those activities were considered active; other participants were considered sedentary. Forty-two nursing home residents (34 women and 8 men) were categorized as active and 34 residents (32 women and 2 men) were categorized as sedentary.

Education, comorbidity, and medication.—We determined the participants' level of education by means of a 7-point scale ranging from 1 (less than elementary school) to 7 (university;

see Verhage, 1964). Because depressive symptoms are associated with rest–activity rhythm disturbances (Carvalho-Bos et al., 2007) and cognitive dysfunction (Swaab, 2004), we used a Dutch version of the Geriatric Depression Scale (GDS; Kok, Heeren, & Van Hemert, 1993; see also Yesavage et al., 1982) to determine the level of participants' depressive symptoms (a higher score indicates more feelings of depression; the maximum score is 30). The Dutch GDS is a validated, pretested translation with similar or somewhat better psychometric properties than the Dutch version of Beck's Depression Scale (Kok et al.).

We also took into account the number of visual disturbances (e.g., macular degeneration, current cataract) as reported in the medical status, because problems of the visual system may have a negative impact on the rest–activity rhythm, as a result of the reduced input to light-sensitive parts of the circadian timing system (Swaab, 2004), or because of an impaired ability to see and avoid object's in one's path. Because other comorbid conditions may also influence the rest–activity pattern and general well-being and thus the level of daily physical activity, we recorded them as well (see Swaab). In particular, painful conditions of the locomotor apparatus (e.g., arthritis) may hinder active participation in daily activities and may lead to rest–activity rhythm disturbances (Roberto, Gigliotti, & Husser, 2005).

In addition, cardiovascular disease is frequently present in dementia (Scherder et al., 2007) and associated with physical activity limitations (Fonarow, 2006). Therefore, we extracted from the medical status those conditions that were reported in the medical status or for which medication was prescribed, and we classified them into specific categories. Finally, we also recorded types of medication, including psychoactive medication (e.g., antipsychotics; Schweitzer, 2000), that may affect rest–activity rhythm or cognition as a side effect.

Instruments

Rest–activity rhythm.—We collected rest–activity data by means of an actigraph activity monitor (Cambridge Neurotechnology Ltd., Cambridge, England). Actigraphs are small, lightweight, wrist-worn activity monitors that present a minimal burden to the participant. The participants wore the actigraph for 4 consecutive days. We analyzed the actigraphy data with a sleep-analysis program (Actiwatch Sleep Analysis Software 2001, Version 1.06, Cambridge Neurotechnology). We computed the following nonparametric variables: interdaily stability, intradaily variability, relative amplitude, and total rest–activity score (for a more detailed description, see Van Someren et al., 1999; also see Carvalho-Bos et al., 2007).

Interdaily stability is a measure of the degree of resemblance across activity patterns of individual days. It gives an indication of the strength of coupling between the rest–activity rhythm to *zeitgebers* (e.g., light input). Higher values indicate a more stable rhythm.

Intradaily variability represents the fragmentation of periods of rest and activity. Normal rest–activity patterns will show one major active period (day) and one major inactive period (night). Therefore, they show a low intradaily variability. Higher values indicate a more fragmented rhythm.

Relative amplitude represents the normalized difference between the most active 10-hour period in the 24-hour cycle (M10) in relation to the uninterrupted, least active 5-hour period (L5). Higher values indicate a larger difference between daytime activity and nighttime rest and thus a stronger rhythm. Within the scope of the present study, we calculated the level of daytime physical activity between 8:00 a.m. and 8:00 p.m. We also calculated the level of physical activity during the night (between 12:00 a.m. and 6:00 a.m.) to control for nocturnal restlessness (higher values indicate more activity).

The total rest–activity score is formed by the summation of the three main rest–activity rhythm variables. We converted the interdaily stability, the inverted intradaily variability, and the relative amplitude into *z* scores and combined them into one total rest–activity score (Cronbach's alpha: $\alpha = 0.77$).

Cognitive functioning.—We had cognitive tests administered by trained research assistants who were blind to study design and participant category assignment. Test assessment took place in each participant's room during the same period when the activity classifications were made. The cognitive outcome measures represented the MMSE, the Digit Span test, the Category Fluency test, the Rivermead Behavioural Memory Test (RBMT), the Eight Words Test, and a total cognition score.

The MMSE (Folstein et al., 1975) involves items that assess orientation, recall, attention, calculation, language, praxis, and visuoconstructive abilities (the maximum score is 30). It provides a measure of global cognitive functioning. The measure is also used to indicate the severity of dementia, with a range between 17 and 24 indicating mild-to-moderate dementia, and an MMSE score of <17 indicating more severe dementia (Bokde et al., 2005).

The Digit Span (Forward and Backward) test is a subtest of the revised Wechsler Memory Scale (Wechsler, 1987). The participant is asked to repeat series of digits in the same order (forward), or in the reversed order (backward). The total number of correctly recalled items forms the outcome variable, with a maximum score of 24. The test provides a measure of a patients' verbal working memory (Wilde, Strauss, & Tulskey, 2004). The Digit Span test has proven to be sufficiently reliable to be interpreted on its own ($r_x = 0.77$; see Elwood, 1991).

The Category Fluency test is a subtest of the Groninger Intelligentie Test (Snijders & Verhage, 1983). The participant is asked to name as many animals and occupations as possible, each during a 1-minute period. The total number of correctly named items forms the outcome variable. This test measures the participants' ability to retrieve familiar information from semantic memory. The reliability and validity of the Groninger Intelligentie Test have been labeled as satisfactory by the Committee on Test Affairs Netherlands (Evers, Van Vliet-Mulder, & Groot, 2000).

We administered two subtests of the RBMT (Wilson, Cockburn, & Baddeley, 1987): the Face Recognition test to measure visual, nonverbal long-term memory (maximum score is 10) and the Picture Recognition test to measure visual, verbal long-term memory (maximum score is 20). The RBMT is an ecologically valid test to assess everyday memory problems (Wills, Clare, Shiel, & Wilson, 2000), and it has a high interrater reliability (Wilson et al.). We converted scores on

both tests to z scores and formed one RBMT test score (Cronbach's alpha: $\alpha = 0.63$).

In the Eight Words Test (Lindeboom & Jonker, 1989), the instructor reads out 8 words in a row. This process is repeated five times, and every time the participant is asked to recall as many words as possible. The first outcome measure is the total number of recalled words (direct recall, with a maximum score of 40). After 15 minutes, the participant is asked to recall as many words as possible (delayed recall, with a maximum score of 8). Next, the examiner names 16 words and the participant is asked to distinguish between words read before and words not read before (delayed recognition, with a maximum score of 16). The three subtests of this test appeal to episodic memory. The reliability and validity of this test are considered satisfactory by the Committee on Test Affairs Netherlands (Evers et al., 2000). We transformed the three subtests into z scores and combined them into one Eight Words Test score (Cronbach's alpha: $\alpha = 0.57$).

We converted all the cognitive variables into z scores and combined them into one total cognition score (Cronbach's alpha: $\alpha = 0.81$).

Statistical Analysis

We analyzed the data by using SPSS Version 11.5 (SPSS, Inc., Chicago, IL). We compared the characteristics of the participants between groups by using an independent-samples t test, a chi-square test, or a Mann-Whitney U test. We conducted analyses of variance on the rest-activity parameters and the cognitive tests. We explored the relationships between the main rest-activity rhythm variables and the cognitive variables within the total group by means of Pearson correlations. To control for spurious results that were due to the multiple analyses performed in the present study, we used an adjusted alpha level of .01 (statistical results with significance levels of $.01 \leq p \leq .05$ were considered as statistical trends). We estimated effect sizes in terms of the partial eta squared or η_p^2 , and, following Cohen's standard (Cohen, 1992), we interpreted them as follows: small, $\eta_p^2 \approx 0.01$; moderate, $\eta_p^2 \approx 0.06$; and large, $\eta_p^2 > 0.13$.

RESULTS

Baseline Characteristics

The mean age of all participants was 84.9 years and did not differ significantly between groups categorized by the nursing staff (for means, standard deviations and t tests, see Table 1). All participants were mildly or moderately demented (MMSE range = 10–24). Most of the participants with dementia were in a moderate stage of dementia (median MMSE = 17). The sedentary and active groups as determined by the nursing staff did not differ significantly in terms of education ($\chi^2 = 8.897$, $df = 5$, $p = .113$). Participants revealed a diagnosis in their medical status that was (a) AD, $n = 25$; (b) vascular dementia, $n = 14$; (c) a combination of AD and vascular dementia, $n = 5$; or (d) dementia not otherwise specified, $n = 32$. The different types of dementias were equally distributed over both groups (see Table 1).

Table 1. Participant Characteristics

	Active Group	Sedentary Group	<i>t</i>	<i>df</i>	<i>p</i>
Demographics: <i>M</i> (<i>SD</i>)					
Age	84.2 (5.1)	85.6 (4.2)	−1.33	74	.189
Depression level ^a	8.0 (5.1)	8.3 (5.4)	−0.28	73	.779
	Frequency (%)		χ^2	<i>df</i>	<i>p</i>
Diagnosis					
AD	15 (36)	10 (29)	0.338	1	.561
VaD	7 (17)	7 (21)	0.237	1	.661
AD + VaD	2 (5)	3 (9)	0.544	1	.478
Dementia NOS	18 (43)	14 (41)	0.004	1	.883
LR conditions					
Arthritis	7 (17)	12 (35)	3.477	1	.062
Osteoporosis	4 (10)	3 (9)	0.005	1	.916
Total hip	4 (10)	4 (12)	0.124	1	.752
Rheumatism	3 (7)	0 (0)	2.468	1	.112
Neck and back problems	8 (19)	8 (24)	0.280	1	.634
Multiple (≥2)	14 (33)	12 (35)	0.032	1	.858
None	15 (36)	9 (27)	0.743	1	.389
Use of walking aid	25 (60)	23 (68)	0.533	1	.465
Comorbidity					
Cardiovascular disorders	36 (86)	31 (91)	0.537	1	.464
Neuropathy and radiculopathy	7 (17)	10 (29)	1.903	1	.185
Renal insufficiency	3 (7)	8 (24)	4.076	1	.044*
Pneumonic disease	13 (31)	11 (32)	0.040	1	.896
Endocrine disorders	10 (24)	11 (32)	0.792	1	.408
Macular degeneration	2 (5)	3 (9)	0.504	1	.478
Cataract	10 (24)	7 (21)	0.112	1	.738
Multiple (>2)	28 (67)	23 (68)	0.008	1	.928
Medication					
Antidepressants	5 (12)	7 (21)	1.159	1	.302
Sedatives	13 (31)	13 (38)	0.443	1	.506
Neuroleptics	8 (19)	5 (15)	0.206	1	.617
Cholinesterase inhibitors	3 (7)	0 (0)	2.468	1	.112
Analgesics	16 (38)	11 (32)	0.197	1	.603
Multiple (≥2)	14 (33)	10 (29)	0.134	1	.715

Notes: Numbers for the table are as follows: active group, $n = 42$; sedentary group, $n = 34$. AD = Alzheimer's disease; VaD = vascular dementia; NOS = not otherwise specified; LR = locomotion related.

^aThe score of one participant is missing as a result of incomprehension.

* $p \leq .05$.

Mood.—The active and the sedentary groups categorized by the nursing staff did not differ significantly on the GDS score (see Table 1). The two groups also did not differ in number of people that were prescribed antidepressant medication (see Table 1).

Comorbidity and medication.—The two groups categorized by the nursing staff did not show a significant difference with respect to the total number of medical diagnoses reported in the medical status (Mann-Whitney U test: $z = -0.75$, $p = .456$) or with respect to types of medication (Mann-Whitney U test: $z = -0.89$, $p = .376$). More specifically, there were no differences between groups concerning the number of total conditions that affect the locomotor apparatus (Mann-Whitney U test: $z =$

Table 2. Means, Standard Deviations, and Univariate ANOVAs of the Actigraphy Variables and the Neuropsychological Tests

	Active Group		Sedentary Group		ANOVA			
Variable or Test	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>df</i>	<i>p</i>	η_p^2
AV								
Activity 8 a.m.–8 p.m.	133.74	64.95	92.29	44.66	10.00	1, 74	.001**	.119
Activity 12 a.m.–6 a.m.	39.82	30.86	32.67	19.73	1.38	1, 74	.123	.018
Interdaily stability	0.64	0.10	0.59	0.13	3.38	1, 74	.035*	.044
Intradaily variability	1.22	0.27	1.38	0.32	5.99	1, 74	.009**	.075
RA								
	0.79	0.13	0.74	0.15	2.91	1, 74	.046*	.038
Total rest–activity score	0.21	0.73	−0.24	0.89	5.92	1, 74	.009**	.074
Cognitive tests								
MMSE	17.93	3.92	16.24	3.83	3.58	1, 74	.032*	.046
Digit Span	9.05	2.72	8.03	2.34	2.95	1, 74	.045*	.038
Category Fluency	14.88	7.05	12.47	6.22	2.44	1, 74	.062	.032
RBMT	0.07	0.80	−0.08	0.92	0.56	1, 73	.223	.008
Eight Words Test	0.03	0.68	−0.04	0.79	0.15	1, 74	.348	.002
Total cognition score	0.10	0.55	−0.12	0.62	2.66	1, 74	.054*	.035

Notes: ANOVA = analysis of variance; AV = actigraphy variable; RA = relative amplitude; MMSE = Mini-Mental State Examination; RBMT = Rivermead Behavioural Memory Test. One-sided *p* values were used.

p* ≤ .05; *p* < .01.

–1.11, *p* = .266), number of visual disturbances (Mann Whitney *U* test: *z* = –0.59, *p* = .558), and number of psychoactive medication (Mann Whitney *U* test: *z* = –0.193, *p* = .847). For more specific types of comorbidity (e.g., comorbidities that affect locomotor apparatus, or macular degeneration and current cataract), see Table 1. Apart from a nonsignificant difference concerning renal insufficiency, specific categories of illnesses did not differ between groups (see Table 1).

Rest–Activity Rhythm

Daytime physical activity.—As we expected, the level of activity between 8:00 a.m. and 8:00 p.m. measured by the actigraph indicated that daytime physical activity was significantly higher in the group that was described as active by the nursing staff compared with the group that was categorized as sedentary (for means, standard deviations and statistics, see Table 2). This difference showed a moderate-to-large effect size. People in the group categorized as active who had multiple comorbidities of the locomotor apparatus showed an equal amount of physical activity during the day as did those without any comorbidities of the locomotor apparatus: *F*(1,40) = 1.916, *p* = .174.

Total rest–activity score.—The total rest–activity score differed significantly between groups categorized by the nursing staff, showing a moderate effect size. The group that was considered active revealed a higher combined *z* score.

Intradaily variability.—Concerning the main rest–activity variables, the difference between the mean scores of both groups on the variable of intradaily variability was significant, showing a moderate effect size. Intradaily variability was lower in the group that was described as active by the nursing staff than in the group that was considered sedentary.

Interdaily stability.—Compared with this sedentary group, the active group had higher mean interdaily stability scores.

Although this difference was not significant, it showed a trend and a small-to-moderate effect size. Twenty-three percent of this sedentary group revealed interdaily stability that was at or above the median interdaily stability of the active group.

Relative amplitude.—The difference between groups concerning the mean scores on the relative amplitude variable approached significance and showed a small-to-moderate effect size; the group that was described as sedentary by the nursing staff showed the smallest relative amplitude. Half of the people in this sedentary group showed a relative amplitude that was at or above the median relative amplitude in the active group. The level of physical activity during the night, that is, between 12:00 a.m. and 6:00 a.m., did not differ between groups (for means, standard deviations, and statistics, see Table 2).

Stage of dementia.—We performed separate analyses between the groups categorized by the nursing staff to compare subgroups that were in a mild-to-moderate stage of dementia with those in a more severe stage of dementia. Differences concerning the rest–activity rhythm variables between the group that was considered active and the group that was considered sedentary were more pronounced in the subgroup that showed more severe dementia (.007 < *p* < .115 and .042 < η_p^2 < .166) than in the subgroup that showed mild-to-moderate dementia (.032 < *p* < .271 and .010 < η_p^2 < .088).

Cognitive Functioning

There were no significant differences in cognitive functioning between groups categorized by the nursing staff, although there was a trend for MMSE and Digit Span scores to be lower in the group that was categorized as sedentary (for means, standard deviations, and statistics, see Table 2). In the analyses in which the groups determined by the nursing staff were divided into persons with mild-to-moderate and more severe dementia, we found no significant differences between the active and sedentary groups (.076 < *p* < .463 and .000 < η_p^2 < .054).

Table 3. Pearson Correlations (*r*) Between the Rest–Activity Rhythm Variables and the Cognitive Variables in the Total Group

	MMSE		DS		CFLU		RBMT		8WT		TGS	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
Activity 8 a.m.–8 p.m.	.07	.28	.14	.12	.13	.14	.11	.18	.06	.30	.14	.12
Activity 12 a.m.–6 a.m.	.09	.22	-.01	.47	.09	.22	.03	.40	.09	.23	.07	.28
Interdaily stability	.13	.13	.10	.20	.26	.02*	.17	.07	.08	.24	.19	.05*
Intradaily variability	-.04	.36	-.07	.29	-.01	.49	-.06	.30	.01	.47	-.03	.42
RA	.07	.29	.08	.25	.11	.18	.25	.02*	.04	.32	.17	.07
Total rest–activity score	.10	.21	.10	.20	.15	.10	.20	.05*	.05	.33	.16	.09

Notes: For the total group, *n* = 76. MMSE = Mini-Mental State Examination; DS = Digit Span; CFLU = Category Fluency; RBMT = Rivermead Behavioural Memory Test; 8WT = Eight Words Test; TGS = total cognition score; RA = relative amplitude. One-sided *p* values were used.

**p* ≤ .05.

Relationship Between the Rest–Activity Rhythm Variables and the Cognitive Tests

Correlations between the cognitive variables and the rest–activity variables, including level of activity during the day and during the night, were not significant (see Table 3). Pearson correlations between interdaily stability and Category Fluency test scores and the total cognition score showed a trend, but correlations were low. In addition, correlations between the RBMT score and the relative amplitude and the total rest–activity score showed trends but were low.

DISCUSSION

Rest–Activity Rhythm

Within this group of ambulatory nursing home residents with moderately advanced dementia (median MMSE = 17), the actigraphy data revealed considerable differences in daily physical activity level between the group that was considered active and the group that was considered sedentary by the nursing staff. One may argue that the group that was considered sedentary might suffer from more (though not significant) locomotor disturbances. However, the people in the active group who showed multiple comorbidities of the locomotor apparatus did not show less physical activity during the day compared with those without comorbidities of the locomotor apparatus. Besides a significant difference in daily physical activity, the group that was considered sedentary showed a less stable rest–activity rhythm across days, a more fragmented rhythm within a day, and a smaller difference between periods of rest and activity than did the group that was considered active. Of course, the latter finding is not surprising in view of the overall lower level of physical activity.

Cognitive Functioning

Contrary to our expectation, we found no significant differences between the group that was considered active and the group that was considered sedentary with respect to cognitive functioning. One possible explanation for this lack of a difference may be the low level of *overall* physical activity in general in the present study population. It has been reported that, for physical activity to benefit cognition, aerobic physical activity of a moderate magnitude of intensity is required (Colcombe & Kramer, 2003). The present data support these findings, because the present study population did not participate in any aerobic physical activity program; some people were just slightly more physically active than others.

Considering the low level of physical activity in our population, one may wish to replace a dichotomous categorization (active–sedentary), which indicates a restricted range of physical activity, by a continuous measure of level of physical activity in future research. One example would be the actual number of activities that people engaged in.

Variability Between and Within Participants

A striking finding was that, despite the fact that the entire group of ambulatory older nursing home residents was sedentary, and despite the similarity of the participants with respect to age, level of dementia, and presence of comorbidity, some variability across participants in several aspects was still shown. More specifically, there was variability in terms of their daily level of physical activity. Differences between the nursing home residents with respect to their rest–activity rhythm were of moderate magnitude. Interestingly, when dividing the participants into groups of people with mild-to-moderate and more severe dementia, we found that differences in rest–activity rhythm between the active and the sedentary groups as determined by the nursing staff were more apparent in the more severely demented group. An explanation for this finding might be as follows. People with more severe dementia show a more disrupted functioning of the suprachiasmatic nucleus (Stopa, Volicer, Kuo-Leblanc, Harper, Lathi, Tate, et al., 1999). It can be argued that the more the biological clock is impaired, the more its functioning depends on stimuli such as those that arise from physical activity. Being in an advanced stage of dementia and being sedentary may have a more negative effect on a person's rest–activity rhythm than being in a more advanced stage but still physically active.

Besides this variability between the groups categorized by the nursing staff, there was also a large intraindividual variability. This intraindividual variability might be associated with age (Huang et al., 2002), the severity of cognitive impairment (Dixon et al., 2007), or the nature of neurological disturbance (Burton, Strauss, Hultsch, Moll, & Hunter, 2006). However, intraindividual variability does not necessarily indicate vulnerability in older people (Allaire & Marsiske, 2005). In addition to variability in the rest–activity rhythm, intraindividual variability in dementia has been reported for agitation, cognition, and physical function (Martin, Marler, Shochat, & Ancoli-Israel, 2000; Strauss, MacDonald, Hunter, Moll, & Hultsch, 2002). More specifically, nursing home residents show a greater variability across cognitive domains;

this, in turn, is associated with functional decline (Rapp, Schnaider-Beeri, Sano, Silverman, & Haroutunian, 2005).

Study Limitations

At this point, we should note that several factors may limit the interpretation of our findings. First, the level of depression was determined by the GDS (Kok et al., 1993). Although the GDS has been used in older people with dementia (Orsitto et al., 2007), some researchers have argued that it may not be the best way to assess symptoms of depression in dementia (Kørner et al., 2006). Related to this issue, assessing symptoms of depression in older people with dementia is difficult because of the overlap of symptoms of depression and dementia, such as difficulty concentrating and apathy (Hoogendijk, 1998). Future studies could benefit from an instrument that is specifically designed for this particular population (e.g., the Cornell Scale for Depression in Dementia; see Alexopoulos, Abrams, Young, & Shamoian, 1988).

A second limitation of the present study was that we did not take into account exposure to light. One may argue that, on one hand, being more active may be associated with receiving more input of light. On the other hand, people that were sitting down most of the day may have been sitting in the light, whereas more active people may have been walking through somewhat darker hallways. Light is an important *zeitgeber* in the rest–activity rhythm, and increased exposure to light benefits rest–activity disturbances and may improve cognitive functioning in dementia (Ancoli-Israel et al., 1997; Forbes et al., 2004). In future studies, this variable should be controlled for.

A third limitation is that the classification by the nursing staff was performed only once and by nursing staff teams of different nursing homes, precluding a determination of interrater reliability. In addition, categorization was based on the recollection of the nursing staff and it remains uncertain *what kind of* physical activity the participants of the present study were actually performing. Certain types of daily physical activities are more strenuous than other types of activity, for example, knitting versus setting the table (Ainsworth et al., 1993). Unfortunately, it was not feasible in the present study to continuously monitor the nursing home residents, because the resulting work load would be too much for the nursing staff. However, despite the lack of specific information on which type of activities were actually engaged in, the categorization by the nursing staff did correspond to the actigraphy data.

Finally, information on specific subtypes of dementia of the participants was lacking. It may be the case that rest–activity disturbances differ across subtypes of dementia. For example, patients with frontotemporal dementia can show more rest–activity disturbance than do patients with AD (Liu et al., 2004). Taking into account dementia subtype allows for more specific inferences concerning the relationships among physical activity, rest–activity rhythm, and cognitive functioning. However, this problem is difficult to resolve, as a definite diagnosis of dementia subtype can only be established by means of brain autopsy (Dickson, 2001).

Conclusions

In the present study we examined the extent to which nursing home residents show variability in physical activity, the rest–

activity rhythm, and cognitive functioning. We focused on ambulatory nursing home residents living on psychogeriatric wards. Although most patients were already in a moderately advanced stage of dementia, we found considerable differences in the level of physical activity and rest–activity rhythm between the active and sedentary groups as categorized by the nursing staff. Another important finding was that no significant differences between groups were found with respect to cognitive functioning. In line with previous studies, nursing staff's assessment of patients' activity levels converged with the results of our actigraphy measurements. Their accurate assessment is of clinical significance because nursing staff have intimate contact with the residents and can stimulate their activity levels. The fact of whether or not nursing home residents with dementia benefit from extra stimulation by the nursing staff to engage in more physical activity should be determined in future randomized, controlled, clinical trials.

ACKNOWLEDGMENTS

Thanks to Dick F. Swaab and Mante S. Nieuwland for their excellent commentaries and suggestions.

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REFERENCES

- Ainsworth, B. E., Haskell, W. L., Leon, A. S., Jacobs, D. R., Jr., Montoye, H. J., Sallis, J. F., et al. (1993). Compendium of physical activities: Classification of energy costs of human physical activities. *Medicine and Science in Sports and Exercise*, 25, 71–80.
- Alexopoulos, G. S., Abrams, R. C., Young, R. C., & Shamoian, C. A. (1988). Cornell Scale for Depression in Dementia. *Biological Psychiatry*, 23, 271–284.
- Allaire, J. C., & Marsiske, M. (2005). Intraindividual variability may not always indicate vulnerability in elders' cognitive performance. *Psychology and Aging*, 20, 390–401.
- Ancoli-Israel, S., Klauber, M. R., Jones, D. W., Kripke, D. F., Martin, J., Mason, W., et al. (1997). Variations in circadian rhythms of activity, sleep, and light exposure related to dementia in nursing-home patients. *Sleep*, 20, 18–23.
- Bliwise, D. L. (2004). Sleep disorders in Alzheimer's disease and other dementias. *Clinical Cornerstone*, 6(Suppl. 1A), S16–S28.
- Bokde, A. L., Teipel, S. J., Drzezga, A., Thissen, J., Bartenstein, P., Dong, W., et al. (2005). Association between cognitive performance and cortical glucose metabolism in patients with mild Alzheimer's disease. *Dementia and Geriatric Cognitive Disorders*, 20, 352–357.
- Bonanni, E., Maestri, M., Tognoni, G., Fabbrini, M., Nucciarone, B., Manca, M. L., et al. (2005). Daytime sleepiness in mild and moderate Alzheimer's disease and its relationship with cognitive impairment. *Journal of Sleep Research*, 14, 311–317.
- Burton, C. L., Strauss, E., Hultsch, D. F., Moll, A., & Hunter, M. A. (2006). Intraindividual variability as a marker of neurological dysfunction: A comparison of Alzheimer's disease and Parkinson's disease. *Journal of Clinical and Experimental Neuropsychology*, 28, 67–83.
- Carvalho-Bos, S. S., Riemersma-Van Der Lek, R. F., Waterhouse, J., Reilly, T., & Van Someren, E. J. (2007). Strong association of the rest–activity rhythm with well-being in demented elderly women. *The American Journal of Geriatric Psychiatry*, 15, 92–100.
- Churchill, J. D., Galvez, R., Colcombe, S., Swain, R. A., Kramer, A. F., & Greenough, W. T. (2002). Exercise, experience and the aging brain. *Neurobiology of Aging*, 23, 941–955.

- Cohen, J. (1992). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Erlbaum.
- Colcombe, S., & Kramer, A. F. (2003). Fitness effects on the cognitive function of older adults: A meta-analytic study. *Psychological Sciences*, 14, 125–130.
- Craig, D., Mirakhur, A., Hart, D. J., McIlroy, S. P., & Passmore, A. P. (2005). A cross-sectional study of neuropsychiatric symptoms in 435 patients with Alzheimer's disease. *The American Journal of Geriatric Psychiatry*, 13, 460–468.
- Cramer, G. W., Chaponis, R. J., Bauwens, S., & Chamberlain, T. (1999). Evaluation of sleep disorders in nursing facilities. *The Consultant Pharmacist*, 14545–548, 553–556.
- Dickson, D. W. (2001). Neuropathology of Alzheimer's disease and other dementias. *Clinics in Geriatric Medicine*, 17, 209–228.
- Dixon, R. A., Garrett, D. D., Lentz, T. L., MacDonald, S. W., Strauss, E., & Hultsch, D. F. (2007). Neurocognitive markers of cognitive impairment: Exploring the roles of speed and inconsistency. *Neuropsychology*, 21, 381–399.
- Elwood, R. W. (1991). The Wechsler Memory Scale-Revised: Psychometric characteristics and clinical application. *Neuropsychology Review*, 2, 179–201.
- Evers, A., Van Vliet-Mulder, J. C., & Groot, C. J. (2000). *Documentatie van tests en testresearch in Nederland* [Documentation of tests and test research in The Netherlands]. Assen: Van Gorcum & Comp. B.V.
- Fonarow, G. C. (2006). How well are chronic heart failure patients being managed? *Reviews in Cardiovascular Medicine*, 7(Suppl. 1), S3–S11.
- Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). Mini-Mental State: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, 12, 189–198.
- Forbes, D., Morgan, D. G., Bangma, J., Peacock, S., Pelletier, N., & Adamson, J. (2004). Light therapy for managing sleep, behaviour, and mood disturbances in dementia. *Cochrane Database Systematic Reviews*, 2, CD003946.
- Gehrman, P. R., Martin, J. L., Shochat, T., Nolan, S., Corey-Bloom, J., & Ancoli-Israel, S. (2003). Sleep-disordered breathing and agitation in institutionalized adults with Alzheimer disease. *The American Journal of Geriatric Psychiatry*, 11, 426–433.
- Hermans, D. G., Htay, U. H., & McShane, R. (2007). Non-pharmacological interventions for wandering of people with dementia in the domestic setting. *Cochrane Database of Systematic Reviews*, 1, CD005994.
- Hoogendijk, W. J. (1998). *Brain changes in depression. A combined clinical and post-mortem study in depressed patients with or without Alzheimer's or Parkinson's disease*. Amsterdam: VU University Press.
- Huang, Y. L., Liu, R. Y., Wang, Q. S., Van Someren, E. J., Xu, H., & Zhou, J. N. (2002). Age-associated difference in circadian sleep-wake and rest-activity rhythms. *Physiology & Behavior*, 76, 597–603.
- Koch, S., Haesler, E., Tiziani, A., & Wilson, J. (2006). Effectiveness of sleep management strategies for residents of aged care facilities: Findings of a systematic review. *Journal of Clinical Nursing*, 15, 1267–1275.
- Kochersberger, G., McConnell, E., Kuchibhatla, M. N., & Pieper, C. (1996). The reliability, validity, and stability of a measure of physical activity in the elderly. *Archives of Physical Medicine and Rehabilitation*, 77, 793–795.
- Kok, R. M., Heeren, Th. J., & Van Hemert, A. M. (1993). De Geriatric Depression Scale. *Tijdschrift voor Psychiatrie*, 35, 416–421.
- Körner, A., Lauritzen, L., Abelskov, K., Gulmann, N., Marie Brodersen, A., Wedervang-Jensen, T., et al. (2006). The Geriatric Depression Scale and the Cornell Scale for Depression in Dementia. A validity study. *Nordic Journal of Psychiatry*, 60, 360–364.
- Lindeboom, J., & Jonker, C. (1989). *Amsterdamse Dementie-screeningtest, handleiding* [Amsterdam Dementia Screening Test, manual]. Lisse: Swets & Zeitlinger.
- Liu, W., Miller, B. L., Kramer, J. H., Rankin, K., Wyss-Coray, C., Gearhart, R., et al. (2004). Behavioral disorders in the frontal and temporal variants of frontotemporal dementia. *Neurology*, 62, 742–748.
- Martin, J., Marler, M., Shochat, T., & Ancoli-Israel, S. (2000). Circadian rhythms of agitation in institutionalized patients with Alzheimer's disease. *Chronobiology International*, 17, 405–418.
- McCurry, S. M., & Ancoli-Israel, S. (2003). Sleep dysfunction in Alzheimer's disease and other dementias. *Current Treatment Options in Neurology*, 5, 261–272.
- McCurry, S. M., Logsdon, R. G., Teri, L., Gibbons, L. E., Kukull, W. A., Bowen, J. D., et al. (1999). Characteristics of sleep disturbance in community-dwelling Alzheimer's disease patients. *Journal of Geriatric Psychiatry and Neurology*, 12, 53–59.
- Nagels, G., Engelborghs, S., Vloeberghs, E., Lemmens, W., Pickut, B. A., & De Deyn, P. P. (2007). Correlation between actigraphy and nurses' observation of activity in dementia. *International Journal of Geriatric Psychiatry*, 22, 84–86.
- Orsitto, G., Seripa, D., Panza, F., Franceschi, M., Cascavilla, L., Placentino, G., et al. (2007). Apolipoprotein E genotypes in hospitalized elderly patients with vascular dementia. *Dementia and Geriatric Cognitive Disorders*, 23, 327–333.
- Paavilainen, P., Korhonen, I., Lötjönen, J., Cluitmans, L., Jylhä, M., Särälä, A., et al. (2005). Circadian activity rhythm in demented and non-demented nursing-home residents measured by telemetric actigraphy. *Journal of Sleep Research*, 14, 61–68.
- Rapp, M. A., Schnaider-Beeri, M., Sano, M., Silverman, J. M., & Haroutunian, V. (2005). Cross-domain variability of cognitive performance in very old nursing home residents and community dwellers: Relationship to functional status. *Gerontology*, 51, 206–222.
- Richards, K. C., Beck, C., Shue, V. M., & O'Sullivan, P. S. (2005). Demographic and sleep characteristics in cognitively impaired nursing home residents with and without severe sleep/wake pattern inefficiency. *Issues in Mental Health Nursing*, 26, 751–769.
- Roberto, K. A., Gigliotti, C. M., & Husser, E. K. (2005). Older women's experiences with multiple health conditions: Daily challenges and care practices. *Health Care for Women International*, 26, 672–692.
- Scherder, E. J., Eggermont, L. H., Sergeant, J. A., & Boersma, F. (2007). Physical activity and cognition in Alzheimer's disease: A relationship to vascular risk factors, executive functions and gait. *Reviews in the Neurosciences*, 18, 149–158.
- Schliebs, R., & Arendt, T. (2006). The significance of the cholinergic system in the brain during aging and in Alzheimer's disease. *Journal of Neural Transmission*, 113, 1625–1644.
- Schnelle, J. F., Alessi, C. A., Al-Samarrai, N. R., Fricker, R. D., Jr., & Ouslander, J. G. (1999). The nursing home at night: Effects of an intervention on noise, light, and sleep. *Journal of the American Geriatrics Society*, 47, 430–438.
- Schweitzer, P. K. (2000). Drugs that disturb sleep and wakefulness. In M. H. Kryger, T. Roth, & W. C. Dement (Eds.), *Principles and practice of sleep medicine* (3rd ed., pp. 441–461). Philadelphia: Saunders.
- Snijders, J. T., & Verhage, F. (1983). *Groninger Intelligentie Test*. Lisse: Swets & Zeitlinger.
- Stopa, E. G., Volicer, L., Kuo-Leblanc, V., Harper, D., Lathi, D., Tate, B., et al. (1999). Pathologic evaluation of the human suprachiasmatic nucleus in severe dementia. *Journal of Neuropathology and Experimental Neurology*, 58, 29–39.
- Stout, J. C., Wyman, M. F., Johnson, S. A., Peavy, G. M., & Salmon, D. P. (2003). Frontal behavioral syndromes and functional status in probable Alzheimer disease. *The American Journal of Geriatric Psychiatry*, 11, 683–686.
- Strauss, E., MacDonald, S. W., Hunter, M., Moll, A., & Hultsch, D. F. (2002). Intraindividual variability in cognitive performance in three groups of older adults: Cross-domain links to physical status and self-perceived affect and beliefs. *Journal of the International Neuropsychological Society*, 8, 893–906.
- Sullivan, S. C., & Richards, K. C. (2004). Predictors of circadian sleep-wake rhythm maintenance in elders with dementia. *Aging & Mental Health*, 8, 143–152.
- Swaab, D. F. (2004). *Human hypothalamus: Basic and clinical aspects. Part I and II—Handbook of clinical neurology*. Amsterdam: Elsevier.
- Van Someren, E. J., Hagebeuk, E. E., Lijzenga, C., Scheltens, P., de Rooij, S. E., Jonker, C., et al. (1996). Circadian rest-activity rhythm

- disturbances in Alzheimer's disease. *Biological Psychiatry*, 40, 259–270.
- Van Someren, E. J., Kessler, A., Mirmiran, M., & Swaab, D. F. (1997). Indirect bright light improves circadian rest–activity rhythm disturbances in demented patients. *Biological Psychiatry*, 41, 955–963.
- Van Someren, E. J., Mirmiran, M., & Swaab, D. F. (1993). Non-pharmacological treatment of sleep and wake disturbances in aging and Alzheimer's disease: Chronobiological perspectives. *Behavioural Brain Research*, 57, 235–253.
- Van Someren, E. J., Swaab, D. F., Colenda, C. C., Cohen, W., McCall, W. V., & Rosenquist, P. B. (1999). Bright light therapy: improved sensitivity to its effects on rest–activity rhythms in Alzheimer patients by application of nonparametric methods. *Chronobiology International*, 16, 505–518.
- Verhage, F. (1964). *Intelligentie en leeftijd: onderzoek bij Nederlanders van twaalf tot zevenenzeventig jaar* [Intelligence and age: Research on Dutch people aged twelve to seventy-seven years old]. Assen: Van Gorcum.
- Wechsler, D. (1987). *Wechsler Memory Scale—Revised*. New York: The Psychological Corporation.
- Wilde, N. J., Strauss, E., & Tulskey, D. S. (2004). Memory span on the Wechsler Scales. *Journal of Clinical and Experimental Neuropsychology*, 26, 539–549.
- Wills, P., Clare, L., Shiel, A., & Wilson, B. A. (2000). Assessing subtle memory impairments in the everyday memory performance of brain injured people: Exploring the potential of the extended Rivermead Behavioural Memory Test. *Brain Injury*, 14, 693–704.
- Wilson, B., Cockburn, J., & Baddeley, A. (1987). *The Rivermead Behavioural Memory Test*. Titchfield: Thames Valley Test Company.
- Yesavage, J. A., Brink, T. L., Rose, T. L., Lum, O., Huang, V., Adey, M., et al. (1982). Development and validation of a geriatric depression screening scale: A preliminary report. *Journal of Psychiatric Research*, 17, 37–49.

Received June 28, 2007

Accepted February 19, 2008

Decision Editor: Karen Hooker, PhD

Association for Gerontology in Higher Education
35TH ANNUAL MEETING AND
EDUCATIONAL LEADERSHIP CONFERENCE
FEBRUARY 26 – MARCH 1, 2009
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